Reproductive Physiology

The Response of Angus Cows to Injection of Prostaglandin and PMS[1,2]

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Story in Brief

This experiment utilized 34 lactating Angus cows and 16 Angus heifers to: (1) test the feasibility of timing PMS injections from a prostaglandin induced estrus; and (2) determine the response of cows injected in mid or late cycle with PMS followed by a prostaglandin injection on the following day.

Estrus was observed in 86% of the cows in an average of 3.4 days after a single intramuscular injection of 33.5 mg of prostaglandin ($PGF_{2\alpha}$-Tham salt). This confirmed the choice of day 3 following prostaglandin as the "average day of estrus" for purposes of timing PMS injections. On this basis, PMS injections given on days 12 and 20 post prostaglandin were considered to have been given on days 9 and 17 of the ensuing estrous cycle.

There were no statistically significant differences in the response observed in the 10 cows in each of the 3 treatment groups receiving 2000 IU PMS either alone or in combination with 33.5 mg prostaglandin. The best superovulatory response was obtained in the cows receiving PMS on day 17 followed by prostaglandin on day 18 (80% of the cows treated had a multiple ovulation). The poorest response was from cows receiving PMS on day 9 followed by prostaglandin on day 10 (40% had multiple ovulations), with the groups receiving only PMS on day 17 slightly better (50% multiple ovulations). However, the cows receiving PMS on day 9 had the best overall conception rate.

These results indicate that PMS injections may be timed from a prostaglandin induced estrus. They further indicate that a combination of PMS and prostaglandin given either in mid or late cycle results in multiple ovulations.

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[2] In cooperation with USDA, Agricultural Research Service, Southern Region.

Introduction

Research on multiple births has been conducted by the Oklahoma Agricultural Experiment Station since 1968. It has demonstrated that it is possible to induce multiple births in beef cows by the injection of the hormone preparation pregnant mare serum (PMS). Approximately one cow out of every four so treated responds with a multiple birth, approximately 60% of which are twins.

Unfortunately, the hormonal induction of multiple births is accompanied by a number of problems. One of these prbolems is the high labor requirements associated with heat detection and hormone injections on an individual cow basis to insure it being given at the proper stage of the estrous cycle.

One possible way to reduce labor would be to synchronize estrus prior to injecting the PMS. This would eliminate the need for heat detection and would permit treatment of cows in groups. Two earlier studies (reported in the 1971 and 1793 Research Reports) using one of the oral progestogens, CAP, demonstrated that this was possible. Unfortunately, the use of oral progestogens has two major drawbacks. The fertility at the synchronized estrus is reduced, and they are no longer available for use, having been taken off the market.

Interest in estrus synchronization has been greatly stimulated in recent years by the discovery that a naturally occurring compound called prostaglandin is very effective in synchronizing estrus. Research at a number of Experiment Stations, including Oklahoma (see the 1975 Research Report) has demonstrated that a single intramuscular injection of prostaglandin into cows with a functional corpus luteum will result in a high percentage of cows coming into estrus within 2 to 4 days. Of equal importance, normal fertility is obtained at this induced estrus.

The purpose of this experiment was to: (1) test the feasibility of timing PMS injections from an "average day of estrus" following a single intramuscular injection of prostaglandin; (2) determine the estrual and superovulatory response of cows to PMS injected at mid cycle when the corpus luteum is regressed by prostaglandins; and (3) to determine whether the response of cows to PMS injected late in the cycle would be enhanced if prostaglandin was injected the following day.

Materials and Methods

This experiment utilized 34 lactating 3 and 4 year old Angus cows and 16 yearling Angus heifers. The experimental design is outlined in Table 1.

Starting in mid-May, the herd was checked twice daily for the oc-

Table 1. Design of Experiment.

Treatment	No. Cows	Day 7-14 of Cycle	Days After PGF-I 12	13	20	21
I	10	PGF-I[1]				
II	10	PGF-I	2000 IU PMS	PGF-II		
III	10	PGF-I		PGF-II		
IV	10	PGF-I			2000 IU PMS	
V	10	PGF-I			2000 IU PMS	PGF-II

[1] All prostaglandin (PGF) injections 33.5 mg $PGF_{2\alpha}$ – Tham sal t,IM .

currence of estrus. Estrus detection was facilitated by the use of vasectomized bulls wearing chin ball markers. Seven to 10 days after they were observed to be in estrus, the cows were given a single intramuscular injection of prostaglandin, hereafter referred to as PGF-I, and assigned to one of five treatment groups. This, and all later prostaglandin injections, consisted of a single intramuscular injection of 33.5 mg $PGF_{2\alpha}$-Tham salt. The cows were checked for the occurrence of estrus following PGF-I but were not bred.

The five treatments used in this experiment were: Treatment I—control, no further treatment and bred at the second estrus following PGF-I; Treatment II—2000 IU PMS injected subcutaneously on day 12 after PGF-I and followed on day 13 by an intramuscular injection of prostaglandin (hereinafter referred to as PGF-II); Treatment III—a single intramuscular injection of prostaglandin (PGF-II) on day 13 following PGF-I. Following the PGF-II injection, cows of Treatment II and III were placed with fertile Angus bulls and bred at the ensuing estrus; Treatment IV—2000 IU PMS injected subcutaneously on day 20 following PGF-I; Treatment V—2000 IU PMS injected subcutaneously on day 20 following PGF-I plus an intramuscular injection of prostaglandin (PGF-II) on day 21. Cows of Treatment IV and V were placed with fertile bulls immediately following their last injection and bred at the ensuing estrus.

Ovulation rates were determined in Treatments II, IV and V by means of a high lumbar laparotomy performed 7 to 14 days after breeding. The ovulation rates of the cows in Treatments I and III were determined by means of rectal palpations carried out 7 to 14 days after breeding at the first estrus post-treatment, fertile bulls ran with the cows for an additional 1½ to 2 months. Pregnancy was diagnosed by rectal palpations performed 45 days after the bulls were removed.

Results and Discussion

A brief explanation of the reasoning behind the design of this experiment should facilitate discussion of the results. The first prostaglandin injection (PGF-I) was given to induce an estrus from which to time later PMS injections. The results from other studies had demonstrated that giving a single prostaglandin injection to cows with a functional corpus luteum would result in a high percentage of the cows coming into estrus within 2 to 4 days. Administering PGF-I to cows only between days 7 and 14 of their cycle insured they would have a functional corpus luteum. For purposes of timing the later PMS injections, day 3 following PGF-I was picked as the "average day of estrus." Thus, on this basis the approximate day of the cycle on which PMS was given was day 9 for Treatment II and day 17 for Treatments IV and V.

Previous experiments on inducing superovulation and multiple births by the injection of gonadotropic hormones, such as PMS, have shown that they are effective only when given late in the cycle. Normally, this is the time when the corpus luteum is beginning to regress, progesterone production is declining and the pituitary of the cow is releasing greater amounts of follicle stimulating hormone that is responsible for the growth of a follicle. Thus, the ovary is at a stage that is responsive to the injection of additional gonadotropins and should respond with the growth of additional follicles. When PMS is injected earlier, such as mid cycle, the large progesterone quantities being produced by the corpus luteum inhibit the growth and development of follicles on the ovary. Thus, estrus and superovulation do not occur.

Since prostaglandin functions in inducing estrus by causing the corpus luetum to regress, the combination of PMS with prostaglandin should remove the functional corpus luteum and result in superovulation at mid cycle. In fact, many commercial ova transfer laboratories believe they can obtain better superovulation by injecting a combination of PMS and prostaglandin at mid cycle rather than PMS alone in late cycle. However, mid cycle treatment may not be desirable for multiple births since the objective of ova transfer labs is to get excessive superovulation, 10 or more eggs, while for multiple births 2 to 4 eggs is more desirable.

One of the big problems associated with the induction of multiple births by PMS injections given late in the cycle has been the great variation in response of the cows. The most marked variation has been in the degree of superovulation obtained. However, there is also considerable variation in the interval between time of injections and estrus and ovulation. The cause of this variation is not known, but one possibility is the regressing corpus luteum of late cycle may be stimulated to produce additional progesterone by the injeced PMS. The degree of this simula-

tion would vary with different cows and lead to different responses to the same dose of PMS. If such was the case, the injection of prostaglandin at or near the time of PMS injection should regress the corpus luteum and eliminate this problem. This was the reason for the inclusion of Treatment V to compare with Treatment IV.

The response of the cows to the various prostaglandin and PMS injections is presented in Table 2 and 3. Table 2 gives occurrence of estrus, and the ovulation rates and conception rates are given in Table 3.

Estrus occurred in 43 (86 percent) of the cows in an average of 3.4 days after the PGF-I injection. As shown in Table 2 the individual

Table 2. The Occurrence of Estrus in Cows Treated with PGF and/or PMS.

	Treatment				
Item	I Control	II PMS Day 12 PGF-II Day 13	III PGF-II Day 13	IV PMS Day 20	V PMS Day 20 PGF-II Day 21
Number of cows	10	10	10	10	10
Estrus following PGF-I					
No. cows in heat	8	6	9	10	10
Days after PGF-I	3.5	3.5	2.8	4.0	3.3
Estrus following PGF-II					
No. cows in heat		7	9		
Days after PGF-II		2.6	3.3		
Estrus following PMS					
No. cows in heat				7	10
Days after PMS				4.6	3.8

Table 3. Ovulation Rates and Conception Rates of Cows in Estrus Following Treatment with PGF and/or PMS.

	Treatment				
Item	I Control	II PMS Day 12 PGF-II Day 13	III PGF-II Day 13	IV PMS Day 20	V PMS Day 20 PGF-II Day 21
No. in estrus	7	7	9	7	10
Ovulation rates	1.0	3.6	1.0	4.9	3.6
No. cows ovulating					
0 eggs	0	0	0	1	0
1 egg	7	3	9	1	2
2-4 eggs	0	2	0	2	5
5+ eggs	0	2	0	3	3
No. cows conceiving to treatment estrus	4	5	5	3	4
No. cows open at end of breeding season	1	2	2	4	6

treatment groups varied slightly from this overall average. However, the results obtained in this study are similar to those of earlier studies and suggests that the "average day of estrus" following prostaglandin is 3 days post-injection.

There were no statistically significant differences between the five groups in: the number of cows showing estrus following PMS and/or PGF-II; or in the number conceiving to the estrus following treatment (Table 3). True, there were variations between groups, but the limited number of cows per group made it possible to determine whether this is a real difference or just due to chance. Therefore, these results must be interpreted as suggesting that a combination of PMS and prostaglandin at either mid cycle or late in the cycle has no detrimental effect on the occurrence of estrus or the fertility of the first estrus following treatment.

However, when the number of open cows at the end of the total breeding season are considered (40% and 60% for Treatment IV and V, respectively), there is some question about both treatments involving PMS injections late in the cycle. There is no ready explanation for this poor performance and suggests the need for additional research involving larger numbers of cows.

If one considers only the estrus and superovulatory response, Treatment V appears to be superior to Treatment IV. All of the cows of Treatment V showed estrus following treatment and 80% had multiple ovulations. In comparison, 70% of the cows of Treatment IV were in estrus and only 50% of the cows treated had multiple ovulations. It should also be noted that 62.5% of the multiple ovulations in Treatment V were the desired 2-4 eggs compared to 40% for Treatment IV. Therefore, this study suggests that the combination of PMS on day 17 of the cycle followed by prostaglandin on day 18 is superior to only PMS on day 17.

The superovulatory response of cows on Treatment II is not as desirable as that of cows on Treatment V (40% of the cows treated had multiple ovulations, 50% of which were 2-4 eggs). However, the conception rates, particularly for the entire breeding season, favor Treatment II. These results suggest that the combination of PMS and prostaglandin at mid cycle shows promise as a means of inducing multiple births and is worthy of additional study.

The results reported in Table 2 suggests that cows given a combination of PMS and prostaglandin come in heat quicker than those given either PMS or prostaglandin alone. The differences are not statistically significant, but in both cases (Treatment II compared to Treatment III and Treatment IV compared to Treatment V) they are in the same direction.

The results obtained in this study suggest that PMS injections may be timed from an estrus induced by injecting prostaglandins. They further suggest that a combination of PMS plus prostaglandin may be used to induce superovulation at mid-cycle or to improve the superovulatory response to PMS injected late in the cycle.

Reproductive Performance of Range Cows with Various Suckling Intensities

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Story in Brief

At calving, 44 Hereford x Holstein cows were assigned to one of three suckling intensities; own single calf, a single foster calf or a foster calf and their own calf. The cows were maintained under range conditions and supplemented so body weight loss during October to April was similar for all treatments. Cows nursing two calves had a longer interval after calving until plasma progesterone increased to greater than 1 ng/ml than cows nursing only one calf. Increasing the suckling intensity also increased the interval until the first heat after calving. By 90 days after calving, 71.4% of the cows nursing their own calves had exhibited estrus but only 42.8% of the cows nursing two calves had been in heat. These data indicate that increasing the suckling intensity increased the postpartum anestrous period in range cows although percent body weight loss was similar in cows nursing one or two calves.

Introduction

Any effort to improve the productive efficiency of range cows must be directed towards insuring that every cow weans a calf each year. If a cow is to have a calving interval of 12 months or less, she must calve, resume having estrous cycles, be bred and conceive within a period of no

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